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PRELIMINARY NOTES ON THE "CHAZY" FORMATION IN THE VICINITY OF OTTAWA.*

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The strata which lie between the Beekmantown and the Black River in the Ottawa Valley have been referred to the Chazy, principally on account of their stratigraphic position. Their character and distribution have been described in the "Geology of Canada," 1863, pp.123-130, and in more detail by Dr. Ells in reports accompanying the various maps covering the region.

The fauna of this formation is unlike the fauna of the typical Chazy of the Champlain Valley in New York and Vermont, and its extension in Canada, and the writer has recently begun some studies at various places between Ottawa and Montreal, with the hope of finding the reason for this change. The present paper is a preliminary one, prepared for the purpose of showing the lithological characters and the range of the principal fossils in the formation near Ottawa.

Since the first description of the formation two members have been defined. The lower portion consists of sandstone and shale, and the upper portion of limestone. The two members have been mapped separately by Dr. Ells, and their distribution in the vicinity of Ottawa is well shown on his map of the region. At the base of the formation are layers of coarse-grained conglomerates and sometimes arkose, lying on the fine-grained dolomites of the Beekmantown. The top of the formation does not appear to have been definitely defined, but it would seem from the maps and descriptions that all the limestone up to the black, lumpy, cephalopod-bearing beds of the Black River were included in the Chazy.

In the vicinity of Ottawa both the sandstone and limestone are fairly well exposed, but no one exposure presents a good

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section of the entire thickness. In order to get an idea of the whole formation, it is, therefore, necessary to measure the rocks exposed at each favorable outcrop, and correlate the various sections. Fortunately there are a few beds which may easily be recognized by their lithology and fossils. One of the most useful of these beds is a very black thin-bedded shale containing *Isochilina? clavigera*, a large and easily recognized ostracod. This bed is exposed opposite Mr. Sowter's house on Broad Street, Aylmer, beside the electric railway one mile west of Westboro, near the ruins of Skead's Mill, and was revealed in a trench on Buena Vista Road, at the corner of Minto Place, Rockcliffe, during excavations made this last summer. A second horizon is indicated by thin-bedded limestone containing *Onchometopus simplex*, and always followed by a layer full of a species of *Beatricea*. This horizon was found at Aylmer, Mechanicsville, and on a road leading to the river from a point just east of Robilliard's quarries on the Montreal Road. A few other easily recognized beds have been found useful in checking up the correlations made on the basis of the two just described.

SECTIONS.

The lower portion of the formation is best displayed at Rockcliffe, where the following section was measured, the beds being given in descending order:—

	Ft.	Ft.
4. Green shale with numerous <i>Lingula</i>	5	5
3. Heavy-bedded, light gray sandstone.....	10	15
2. Rather heavy-bedded light gray sandstone with some cross-bedding, and thin layers of coarse grains of sand. <i>Camarotoechia plena</i> and <i>Hebertella imperator</i> at the base.....	10	25
1. Shaly, thin-bedded, light colored sandstone with lenses of heavy-bedded sandstone. <i>Rusophycus grenillensis</i> and other burrows and trails are common.....	53	78

At this locality the base of the black layer with *Isochilina? clavigera* is about 31 feet above the top of this section. A large part of the intervening strata are concealed here, but are well exposed at the Hogs Back, where the following section was measured.

	Ft.	In.	Ft.	In.
7. Dark brown and black shale with ostracods.....	4		4	
6. Rather pure, dark gray limestone with ostracods and bryozoa.....	1		5	



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|---|----|----|----|----|
| 5. Gray shale, calcareous in places, with 6 in. pure coarse-grained limestone 4 ft. below the top..... | 11 | 6 | 16 | 6 |
| 4. Impure sandy limestone and shale..... | 6 | | 22 | 6 |
| 3. Hard, greenish limestone with abundance of <i>Camarotachia plena</i> | | 10 | 23 | 4 |
| 2. Greenish limestone and shale, with <i>Camarotachia plena</i> near the top..... | 10 | | 33 | 4 |
| 1. Calcareous shale with thin layers of limestone and many thin sandy layers. <i>Glossina belli</i> common..... | 20 | 6 | 53 | 10 |

Isochilina? clavigera was not found in No. 7, although other ostracods were plentiful, but this is undoubtedly the *clavigera* horizon. The hard greenish limestone with *Camarotachia plena* outcrops again in a small cutting in Rockcliffe Park, just below the Buena Vista station on the Electric railway, and is especially well shown in the first bluff south of the town at Rockland, 30 miles east of Ottawa.

The strata immediately above the *clavigera* zone are not fully exposed in any one section, but portions are well shown both at Westboro and at Aylmer. The section at Westboro is as follows:—

	Ft.		In.	
13. Rusty dolomite, "cement bed".....	2		2	
12. Heavy-bedded, light blue limestone, the upper bed full of large undetermined corals.....	10	9	12	9
11. Concealed.....	16		28	9
10. Heavy-bedded, dark gray limestone. One of the upper layers shows wavy bedding, and the highest layer is full of fossils; <i>Lophospira</i> , <i>Helicotoma</i> , etc.	5		33	9
9. Rusty dolomite, "cement bed".....	3		36	9
8. Black shale and very thin layers of dark gray limestone.....	2	6	39	3
7. Concealed.....	1	6	40	9
6. Blue-black, wavy bedded limestone, <i>Cor-nulites</i> and <i>Isochilina</i> abundant.....	6		46	9
5. Concealed.....	2	6	49	3
4. Cream-colored sandstone, full of black phosphatic fragments.....	3		52	3
3. Sandstone and brown shale, the sandstone full of badly preserved bryozoans.....	3		55	3
2. Black shale with <i>Isochilina? clavigera</i> and other ostracods.....	2		57	3
1. Blocky, greenish limestone.....	1		58	3

The strata immediately overlying the *clavigera* zone were well exposed in the trenches at Rockcliffe, especially on Buena Vista Road in front of the residence of Mr. Elfric Drew Ingall of the Geological Survey, who made a large collection of the fossils. A large species of *Loxoceras*, and *Modiolopsis parviuscula* were common in the sandstones, and a few thin beds of limestone associated with them were full of *Leperditia canadensis nana*. A bryozoan, which Dr. Bassler has identified as a *Dekayella* similar to *D. simplex*, Ulrich, was abundant in the sandstone.

Within 20 feet above the *clavigera* zone at Aylmer there are a number of thin layers of limestone almost entirely made up of ostracods, and with the ostracods are found *Helicotoma whiteavsiana*, *Bathyrurus angelini*, and a *Cryptodonta*.

The strata above those exposed at the station on the electric railway are well exposed at the Hogs Back:—

	Ft.	In.	Ft.	In.
8. Blue-gray limestone mostly rather heavy-bedded. Some layers very fossiliferous	10	6	10	6
7. Rather pure dark gray limestone with irregular wavy bedding.	5		15	6
6. Heavy-bedded, fine grained light gray to cream-colored sandstone with <i>Vanuxemia</i> and other lamellibranchs.	4	6	20	
5. Dark gray shale, with two or three thin layers of limestone.	1	8	21	8
4. Heavy-bedded sandstone with many replaced bryozoa.	3	9	25	5
3. Shale and thin-bedded black limestone with ostracods.	4	9	30	2
2. Thin-bedded sandstone and shale.	5	9	35	11
1. Heavy-bedded, greenish limestone.	8	6	44	5

No. 1 of this section is believed to be the same as No. 12 of the section at Westboro.

The sandstone, No. 6 of this section, is a very important one, as from it Mr. W. R. Billings obtained the various species of lamellibranchs described by the late Dr. Whiteaves in vol. XXII, No. 6, of THE OTTAWA NATURALIST. This same layer, with the same fossils, was found on the road leading down to the river just beyond the Robillard quarries on Montreal Road, about 3 miles east of Ottawa. The section there is as follows:—

	Ft.	In.	Ft.	In.
12. Massive, impure, dark gray lumpy limestone with <i>Columnaria halli</i> and <i>Ormoceras tenuiflum</i> near the base. Top not seen. Black River.	6		6	

11. Massive buff limestone, the whole surface covered with <i>Phytopsis tubulosum</i> and <i>Tetradium cellulosum</i>	9	15		
10. Concealed. Loose fragments of limestone with surface covered with <i>Beatricea</i> were seen just above the top of No. 9. About.	6	21		
9. Shaly, buff limestone with <i>Onchometopus simplex</i> and numerous large ostracods.	3	10	24	10
8. Light buff limestone, thin-bedded at top and heavy-bedded at bottom.	7	6	32	4
7. Concealed, below quarry.	5		37	4
6. Rusty yellow dolomite, "cement beds."	5		42	4
5. Massive blue-black and dark gray limestone.	10	6	52	10
4. Hard, cream-colored sandstone with <i>Vanuxemia</i> and other lamellibranchs.	3		55	10
3. Mostly concealed, but with two layers of hard, dark blue limestone exposed.	5	2	61	
2. Thin-bedded shale.	2		63	
1. Impure, dark blue, heavy-bedded limestone with large ostracods, <i>Cyrtodonta</i> , and <i>Bathyurus angelini</i>	2	3	65	3

No. 4 of this section is believed to be the same as No. 6 of the section at the Hogs Back. No. 5 is the same as the cement beds which were formerly quarried at the Ottawa river at Mechanicsville, and at that locality there is a thick layer of dolomitic limestone 3 feet below the base of the cement beds, which yielded the types and a large number of other specimens of the *Bathyurus superbus* described by the writer in the November (1910) number of THE OTTAWA NATURALIST.

The layer with *Beatricea*, which is not well shown in this section, is an important one. It is especially well exposed near the top of the hill north of Aylmer, and it may also be seen about 15 feet below the base of the Black River at Mechanicsville. The section along the river at Mechanicsville is an excellent one for showing the upper and most fossiliferous part of the Lowville. It is as follows:—

	Ft.	In.	Ft.	In.
9. 6 feet of shaly and nodular blue-black limestone, resting on 8 feet of heavy-bedded, impure, dark gray limestone. <i>Strophomena incurvata</i> , <i>Maclurites logani</i> , <i>Columnaria halli</i> , <i>Gonioceras anceps</i> , etc. Black River	14		14	

8. Pure, buff colored limestone full of <i>Tetradium cellulosum</i> and <i>T. columnare</i> . Top of Lowville.	3	17		
7. Pure, buff limestone with numerous molluscan fossils	2	10	19	10
6. One layer rather coarse grained limestone. Full of fragments of <i>Bathyrus spiniger</i>		10	20	8
5. Thin-bedded blue and buff limestone; numerous specimens of <i>Bathyrus extans</i> in the upper part.	7	6	28	2
4. Blue-black limestone with <i>Tetradium</i> <i>cellulosum</i> and <i>Stromatocerium</i>	1		29	2
3. Light gray limestone with numerous limestone pebbles and mollusca		4	29	6
2. Dark gray limestone, the surface covered with <i>Beatricea</i>		10	30	4
1. Dark gray limestone full of large flat limestone pebbles and many fossils. . .	1	9	32	1

THE FAUNA.

At a number of horizons fossils are quite abundant, but as they do not weather out readily they are not easily obtained in identifiable condition.

From the sandstone and shale of the lower part of the sections at Aylmer, Britannia, Deschenes and Rockcliffe, the following species are known:

<i>Hebertella imperator</i> ,	<i>Ctenodonta parvidens</i> ,
<i>Camarotæchia plena</i> ,	<i>Archinacella deformata</i> ,
<i>C. orientalis</i> ,	<i>Raphistoma striatum</i> ,
<i>Lingula lyelli</i> ,	<i>Lophospira billingsi</i> ,
<i>Glossina belli</i> ,	<i>Isotelus arenicola</i> .

At Aylmer, about 80 feet above the base of the section the following species were collected by Mr. T. W. E. Sowter:

<i>Lingula lyelli</i> ,	<i>Ctenodonta parvidens</i> .
<i>Camarotæchia plena</i> ,	<i>Modiolopsis sowteri</i> .

From the greenish limestone above the shale and sandstone at the Hogs Back and elsewhere we have only:—

<i>Glossina belli</i> ,	<i>Hebertella borealis</i> ,
<i>Camarotæchia plena</i> ,	<i>Isotelus</i> sp. ind.

In the *clavigera* zone or in the limestone and sandstone within 20 feet above it we find:—

<i>Modiolopsis parviuscula</i> ,	<i>Isochilina ottawa</i> ,
<i>Sowteria canadensis</i> ,	<i>Isochilina? clavigera</i> ,
<i>Helicotoma whiteaviana</i> ,	<i>I? clavigera clavifracta</i> ,
<i>Loxoceras</i> sp. ind.,	<i>Primitia logani</i> ,
<i>Bathyrus angelini</i> ,	<i>Leperditia canadensis</i> ,
<i>Leperditella labellosa</i> ,	<i>L. amygdalina</i> .

Heavy-bedded limestones from 20 to 40 feet above the *Beyrichia* zone are very fossiliferous in places, but it is difficult to get good specimens. A *Cornulites* is very abundant in some of the layers. The species which have so far been recognized are:

<i>Zygospira recurvirostris</i> ,	<i>Lophospira bicincta</i> ,
<i>Raphistomina lapicida</i> ,	<i>Pterotheca</i> sp. ind.
<i>Lophospira perangulata</i> ,	

The next bed above this which has furnished any good fossils is the cream-colored sandstone which is exposed at the Hogs Back and near Montreal Road. Nearly all the species identified were described by Dr. Whiteaves.

<i>Lingula lyelli</i> ,	<i>Vanuxemia parvula</i> ,
<i>Clionychia ottawaensis</i> ,*	<i>Soweria canadensis</i> ,
<i>C.?</i> <i>gibbosa</i> ,	<i>Holopea</i> sp. ind.,
<i>Modiolopsis jabaformis</i> ,	<i>Spyroceras</i> sp. ind.,
<i>Orthodesma antiquatum</i> ,	<i>Ischilina?</i> <i>armata</i> .†

In a dark gray dolomitic limestone within 10 feet above this layer, the following species have been found:—

<i>Tetradium columnare</i> ,	<i>Bathyrus superbus</i> .
<i>Dalmanella</i> sp. ind.,	

About 15–20 feet above this layer are beds of shaly limestone in which the following species are rather common:—

<i>Dalmanella circularis</i> ,	<i>Bathyrus extans</i> ,
<i>Strophomena incurvata</i> ,	<i>Onchometopus simplex</i> ,
<i>Cyrtodonta huronensis</i> ,	<i>Isotelus</i> sp. ind.

Just above the preceding are thin layers in which a species of *Beatricea* and *Cyrtodonta huronensis* are abundant. In the upper 15 feet of the section fossils are rather abundant, but there does not seem to be a very great variety. The following are the more common ones:—

<i>Tetradium cellulosum</i> ,	<i>Bathyrus extans</i> ,
<i>T. columnare</i> ,	<i>B. spiniger</i> ,
<i>Strophomena incurvata</i> ,	<i>Bumastus milleri</i> ,
<i>Helicotoma planulata</i> ,	<i>Isotelus gigas</i> .
<i>Spyroceras</i> sp.,	

These lists, incomplete as they are, show at once that all the fossils which belong to the typical Chazy are beneath the *clavigera* horizon, and the deposits of Chazy age end with the limestone which at the Hogs Back and Rock-

*Dr. Ulrich writes me that this is probably an *Ambonychia*, and *C.?* *gibbosa* a *Vanuxemia*, while *Vanuxemia parvula* is a *Ctenodonta*. The types are not accessible at this writing.

†Identified by Dr. Ulrich.

land is so full of *Camarotoechia plena*. There is nothing in the typical Chazy which corresponds to the ostracod layers such as the *clavigera* zone and the limestone in the 20 feet above it. Excepting the ostracods, nearly all the fossils from this horizon upward are species found also in the Black River and Trenton. The fauna found in the upper 15 feet is evidently Lowville, *Tetradium cellulosum* and *Bathyrurus extans* being the guide fossils. Many of the fossils found below this layer are known in the Lowville but the absence or rarity of *Tetradium cellulosum* gives the fauna a slightly different aspect. It may be significant that this *Tetradium* first becomes common in beds above the "pebble beds" (No. 1. in the section at Mechanicsville.) The pebbles in these beds are from 1 to 3 inches in diameter and have well rounded edges. They are somewhat greenish in color, and remind one of some of the green limestone layers in the upper part of the Chazy at the Hogs Back. They are in a rather pure limestone matrix which is very fossiliferous, *Cyrtodonta huronensis* being abundant, and cephalopods common. Though it cannot be called a conglomerate, this bed indicates some sort of a physical change, and, coupled with the slight change in fauna, may prove to be of some importance.

While the pebble bed may be the base of the Lowville, it seems more probable that the line should be drawn 35 feet lower down, at the base of the sandstone containing *Clionychia* and *Vanuxemia* (No. 6 of the second section at the Hogs Back and No. 4 of the section on the road beyond Robillard's quarries.)

At the Hogs Back there are two of these thick beds of sandstone, which, coming as they do in the midst of a series of limestones, indicate a pronounced change in the conditions governing sedimentation. The change in the fauna at this point, though not striking, can be seen. The principal difference noted is in the ostracods, which, below this sandstone are often so abundant as to make up the entire mass of certain layers, and, moreover, these ostracods are usually smaller than those found above. Certain species, such as *Isochilina? clavigera* and *Bathyrurus angelini*, are not found above this sandstone.

These rocks which lie above the highest bed containing *Camarotoechia plena* and below the sandstone with *Vanuxemia* and *Clionychia* are similar, lithologically, to a formation which occurs in northwestern New York. This formation was described by Dr. H. P. Cushing,* who gave it the name Pamela. The formation, in New York, is from 60 to 150 feet thick, and consists of 10 to 20 feet of shale and sandstone at the base,

*Bull. Geol. Soc. Am. Vol. 19, p. 55, 1908

followed by beds of blue-black limestone, dove limestone, and gray magnesian limestone. The upper portion of the formation is said to lack the black limestone and to consist of alternations of dove limestone and gray magnesian limestone, light gray to white thin-bedded, impure limestone, and yellow water-lime. It will be noted that this succession is very similar to that shown in the sections presented above. The fauna has not yet been described, but it is said to contain numerous small ostracods, an undescribed *Bathyrurus*, gastropods, cephalopods, and several species of *Tetradium*.

SUMMARY.

The sections in the vicinity of Ottawa show about 250 feet of strata between the Beekmantown and the base of the Black River. These strata are characterized by two groups of species. The lower 125 to 135 feet contain a small fauna, some of whose species are found in the upper part of the Chazy formation of the Champlain Valley, and this portion is undoubtedly to be correlated with the Upper Chazy, or at least with the Upper Chazy as exhibited north and west of Montreal. The writer some years ago suggested the name Aylmer* formation for the Chazy of the Ottawa Valley, and it will probably be well to restrict this term to the beds characterized by the Chazy fossils, and use it as the local designation of these lower beds.

The upper portion of the section consists of 115 to 125 feet of limestone, sandstone and shale, with fossils more nearly akin to those found in the Black River and lacking the typical Chazy species. The fauna of these beds is very imperfectly known, and, owing to the poor state of preservation of the specimens at most localities, its elucidation will require a considerable amount of field work and study. This portion of the section, while united by several species which range throughout the whole thickness, is capable of subdivision into two members, the lower of which contains most of the shale and sandstone, and the upper the pure limestone. The lower portion contains an immense number of small ostracods, and, in the middle, great numbers of gastropods and other fossils. This member is from 65 to 75 feet in thickness.

The upper member is composed mostly of pure limestone, has a larger fauna than either of the other formations, the upper 15 feet being especially fossiliferous. This is the Lowville of the New York section and the thickness is about 50 feet.

*Annals Carnegie Museum, Vol. III, p. 380, 1905.